MIT World (20090507) Roshan Cools - Imaging the Human Striatum and its Modulation by Dopamine (about the lecture)

URL: http://mitworld.mit.edu/video/708

About the Lecture

Researchers have known for some time that the neurotransmitter dopamine is centrally involved in learning and working memory, **Roshan Cools** tells us, and that dopamine-responsive circuits connect these parts of the human brain to other structures like the striatum, which also helps orchestrate motor control. Cools has been investigating in detail how dopamine acts within these cortico-striatal circuits to influence different types of cognitive processing.

Specifically, Cools examined the effects of dopaminergic drugs (compounds that modulate the quantity of dopamine available to neurons, or the neurons' responsiveness to dopamine) on human subjects as they performed a variety of performance tasks. She notes that there's a "huge variability within and across individuals" to such drugs. The same chemical within the same subject may improve performance in one task, and impair it in another. The drug effect depends on an individual's baseline levels of dopamine: If someone starts with suboptimal levels, a dopamine-enhancing drug can restore someone to baseline, whereas someone starting with optimal levels of dopamine might be overdosed by the same drug.

One of Cools' studies looked at the impact of dopaminergic drugs in Parkinson's disease (PD) patients, where "the primary pathology is dopamine depletion in the striatum." This depletion is not uniform, though, in the early and late stages of the disease, and impacts different sites in the striatum. Early stage PD patients suffer more from motor deficiencies than from higher level cortical deficiencies. Through performance tests and fMRI scans,Cools confirmed her hypothesis that in mild PD, dopamine-enhancing medication impaired performance on probabilistic reversal learning (a higher level cognitive task), "presumably by overdosing relatively intact levels of dopamine" in one part of the striatum. Yet these same drugs improved performance on other tasks associated with a part of the striatum concerned with motor systems.

Cools has recently been testing healthy U.C. Berkeley undergrads with dopaminergic drugs, fMRI and PET scans, to see how levels of dopamine impact their performance on different learning tasks. Says Cools, "Dopaminergic medication improves reward- but impairs punishment-

based learning in low-dopamine subjects and PD patients. Conversely, it improves punishment- but impairs reward-based reversal learning in high-dopamine subjects. This shift in the balance between reward- and punishment-based reversal likely reflects modulation by dopamine of striatal processing."

Host

- McGovern Institute for Brain Research at MIT

Series

- The Basal Ganglia in Health and Disease

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- Martinos Imaging Center at the McGovern Institute

Lecture Details

- Location: 46-3002

> "We and others have put forward a dopamine overdose hypothesis to account for the contrasting effects of dopaminergic medication on PD patients. Specifically, the medication doses necessary to remedy dopamine lack in the dorsal striatum...may overdose any area where dopamine levels are relatively intact, namely the ventral striatum."

Roshan Cools

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